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1. Thanks to a genetic breakthrough, a rare rhino species may be rescued from extinction

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Thanks to a genetic breakthrough, a rare rhino species may be rescued from extinction

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Highlight: New research from the San Diego Zoo using just 12 frozen cells suggests we can protect the northern white rhino

Body

Link to Image

As humans continue to encroach on our planet, we are driving a mass ***extinction*** that some experts call a "*biological* ***holocaust***." Since more and more ***species*** are dying, it creates an increasing number of genetic bottlenecks, which make animal and plant survival even more difficult.

Take for example the white rhinoceros (*Ceratotherium simum*), which can be divided into two sub-***species*** that are genetically very similar - but one is relatively thriving while the other is on the brink of ***extinction***.

Scientists using state-of-the-art genetics technology hope to change that - and their *recent research* published in the journal Evolutionary Applications suggests they might be able to pull it off.

Such a feat would not be unprecedented. The southern white rhinoceroses, which is currently the most abundant rhinoceros ***species*** in the world, had been culled down to a population of merely 50 to 200 individuals in the early 20th century. Thanks to rigorous conservation efforts, however, the southern white rhinoceros population had rebounded to roughly 20,000 individuals by 2014 (a surge in poaching around that time has since reduced their population to roughly 18,000).

The southern white rhinoceros' cousin, however, faces a much more dire situation. At the time of this writing, there are only two females from the northern white rhinoceros ***species*** that are still alive. Even if there was a male around, it would not matter, since both females are past the age when they can carry a fetus to term. Poaching, poorly managed land use and other human activities have taken a massive toll.

While a few decades ago this would have entirely doomed the ***species***, cutting edge advances in genetics technology may offer them salvation. Dr. Aryn P. Wilder - a conservation scientist at the San Diego Zoo Wildlife Alliance - decided to study genetic samples from 12 northern white rhinoceroses that had cytogenetically frozen at the San Diego Zoo. Much to her delight, Wilder found that those dozen samples contain enough genetic diversity that one could resurrect them from functional ***extinction***.

Indeed, not only is there enough diversity to allow rhinoceroses to be reproduced through cloning, but the samples from northern white rhinoceroses are actually *more*diverse than those of the southern white rhinoceroses. This means that if scientists are able to bring them back, they will be less likely to encounter a genetic bottleneck, in which individual animals are born unhealthy because their parents are too closely related to each other.

Salon spoke with Wilder about this uplifting news, as well as the practical steps that need to be taken next to save northern white rhinoceroses.

This interview has been lightly edited for length and clarity.

Can you explain how your technology was able to determine that there is enough genetic diversity within these 12 samples to avoid a genetic bottleneck?

We sequenced the genomes of individuals from both ***species***, northern white rhinos and southern white rhinos. When you sequence the genome, you can actually measure the amount of genetic diversity in each of those genomes. And we know that the southern white rhino was able to recover without too much inbreeding. So we used southern white rhinos as a benchmark or metric of a healthy enough population. And so then we asked, "Well, do the cells that we have banked in the frozen zoo, do they have enough genetic diversity to recover in a similar way?"

What we found was that, yes, the northern white rhinos actually have more genetic diversity in their genomes than the southern white rhinos, so we know then that they at least have adequate levels of genetic diversity. The other thing that we wanted to look at was harmful mutations in the genome. So we can actually look at genetic variants in the genome or mutations in the genome, and predict how harmful they might be. If those mutations are in a gene that encodes a protein, we can predict what the protein will look like, and we know that if a mutation causes a change in that protein, it's more likely to be harmful.

We can also look across lots of mammals in other mammal ***species***. If we find that that mutation is very rare or doesn't exist in any other mammal ***species***, and every other mammal ***species*** has the same genetic variant, then we would infer that that mutation is actually really important, or that that position is really important in any change to that position and is likely harmful.

Then we counted up all of the mutations in the northern white rhino genome that were harmful and did the same in the southern white rhino, and then modeled over time what those mutations would do in a restored population and whether those harmful mutations would accumulate and cause fitness declines that made the northern white rhino's fitness lower than the southern white rhino.

Then in order to predict what those mutations would do when a northern white rhino population is restored from banked cells in the frozen zoo, we used genomic simulations and we said, "Okay, well if we were to take eight of those individuals from the frozen zoo, clone them and start a population of over 10 generations, what would that look like? What would fitness look like in generation 1, 2, 3 and all the way through generation 10?"

And then we also modeled taking those same eight individuals, starting the population in generation zero, and then every generation after that we introduced one new cell line into - or one new cloned individual back into - the population. Basically modeling this regenerative source of genetic diversity, or this bank of genetic diversity that we have in the frozen zoo, and we found that the populations that had founders reintroduced every generation, they did much better. They didn't suffer any fitness declines like the ones that were just founded once in generation zero and then allowed to to from there over the next 10 generations.

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What are the next steps now that this technology has demonstrated to work?

What these models have shown is that the source of genetic diversity that we have in these cells is enough to restore a healthy population. But in order to restore a healthy population, we need to be able to use these cell lines and actually clone northern white rhino embryos, or create northern white rhino sperm and eggs that then we can use for in vitro fertilization to make an embryo from there.

We need to implant the embryo into a southern white rhino surrogate mother, and she needs to carry her baby to term, and then critically we need to have a habitat that we can release these rhinos into in the wild. They need to have all of the protections that should have been given to them before their population was reduced to just two females. They need to have protection from poaching. They need to have adequate space and healthy habitats for them to live in.

Do you have any personal stories of interactions you've had with rhinos through your research?

Well, we do have a herd of southern white rhinos here. I've actually never interacted with the northern white rhino because by the time I started at the zoo, there were only three left. There was a male, but he passed away a few years ago. Now it's just the two left. But from what I've seen of the southern white rhinos, the closely related subspecies, they're a very gentle and sweet ***species***. That's not to say that that in the wild they'll be gentle and sweet with you, but I've seen the moms with their babies, and the babies wallowing in the mud, and they're really a unique ***species*** - doing our best to preserve them is really our moral obligation.

I want to emphasize again that these new sorts of cellular technologies are only one tool in the toolbox. We still need to to use all of the traditional conservation methods that we've always used. Like I said before, we still need to protect these ***species*** and their habitats. We can't just expect that these methods are sufficient to save a ***species*** and to end the ***extinction*** crisis. This is just one tool in the toolbox, and the reason we have this tool for this ***species*** is because we thought ahead to bank these cells. There are increasing efforts to create these biobanks of living cells so that we can have this genetic material for the future. I think that banking ***species***, even before banking cells from ***species***, even before they suffer these really severe declines, is going to be a really critical resource for the future.

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